



Particle Physics Division

12-01-01

Mechanical Department Engineering Note

Number: MD-Eng-083

Date: April 5, 2005

Project: NuMi

Project Internal Reference:

Title: NuMI Target Hall "K" Concrete Shield Block Stability

Author(s): Robert J. Woods

Reviewer(s): Ingrid Fang

Key Words: NuMi, Shield Block, "K" Block, Target Hall, Shield Block Stability

Abstract/Summary:

This is a check of the stability of a new "K" concrete shield block when the 1 foot dimension of the block is set on the 3.3 degree slope of the Target Hall floor. In order to achieve a 3.0 factor of safety, a steel clip angle is bolted to the block and anchored to the floor. This calculation also includes the design of the angle and expansion anchors.

The design analysis was performed according to both AISC "Allowable Stress Design" and "Hilti North America Product Technical Guide".

Applicable Codes:

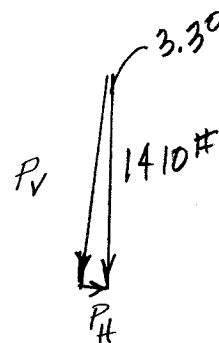
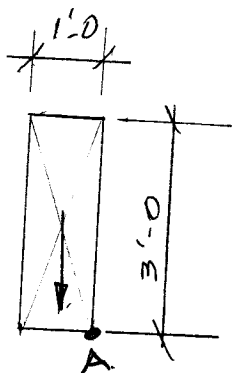
1. AISC Manual of Steel Construction, Allowable Stress Design, Ninth Edition
2. Hilti North American Product Technical Guide 2001 edition.

CHECK STANDARD "K" BLOCK FOR STABILITY:

BLOCK SIZE = 3'-0" x 3'-0" x 1'-0"

WT = 1410 #

FLOOR SLOPE = 3.3°



$$P_H = 1410 (\sin 3.3^\circ) = 81.2"$$

$$P_V = 1410 (\cos 3.3^\circ) = 1407.7 \#$$

RESISTING MOMENT ABOUT POINT "A" =

$$6 (1407.7) = 8446 \#-IN$$

HORIZONTAL LOAD @ TOP OF BLOCK
TO OVERTURN BLOCK:

$$8446 / 36 = 235 \#$$

DESIGN BRACE FOR A FACTOR OF
SAFETY OF 3

$$P_H = 3(235) = 705 \# \text{ MAY } 1000 \#$$

$$\text{MOVERTURNING} = 36(1000) = 36,000 \#-IN$$

$$\text{VERTICAL RESISTING LOAD} = 36,000 / 12" \\ = 3,000 \#$$

DESIGN BRACKET FOR 3,000 #

ASSUMING A MINIMUM OF 4,000 PSI CONCRETE,

$\frac{5}{8}$ " ϕ HILTI DROPIN ANCHOR ALLOWABLE LOAD:

$$\text{TENSION} = 2920 \#$$

$$\text{SHEAR} = 3250 \#$$

MIN ANCHOR SPACING FOR FULL LOAD = 9"

FOR 4" EDGE DISTANCE, SHEAR REDUCTION
FACTOR = 0.65

$$3250 (0.65) = 2112 \#$$

FOR 7" SPACING, REDUCTION FACTOR = 0.74

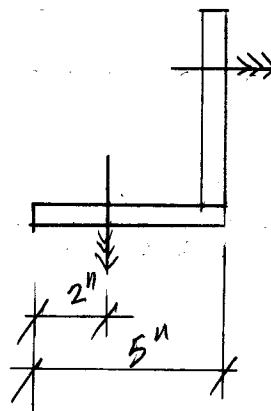
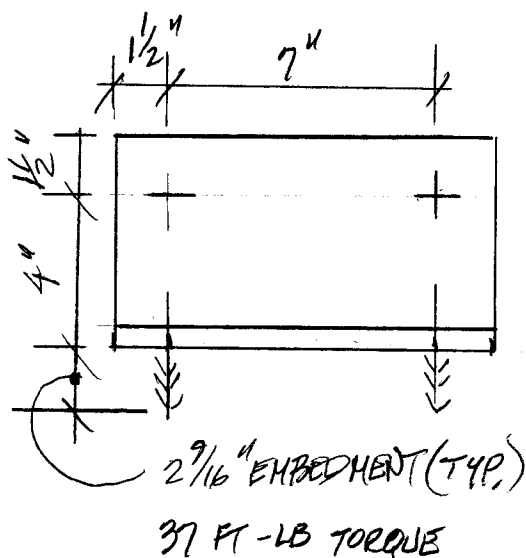
$$2112 (0.74) = 1563 \# \text{ ALLOWABLE SHEAR}$$

$$2920 (0.74) = 2160 \# \text{ ALLOWABLE TENSION}$$

$$\text{USING 2-}\frac{5}{8}\text{"}\phi \text{ BOLTS, ALLOW. LOAD} = 2(1563) \\ = 3126 \# > 3000 \#$$

OK

USE $\frac{1}{2}$ " PLATES:



FOR $\frac{7}{16}$ " WELD:

$$P = 0.3 (.707) (70) (\frac{7}{16}) \\ = 6.5 \text{ K/IN}$$

USE 2-3" LENGTH OF WELD

ALLOWABLE LOAD =

$$2(3)(6.5 \text{ K}) = \\ 39 \text{ K} = 39,000 \# \\ > 3000 \# \text{ OK}$$